

# Beauty and truth in theoretical physics

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There is some controversy about what is meant by a “beautiful theory.” Dirac and many others talked about beauty being a key property of good theories. But what does that mean? Some have countered that the ideas of beauty in physics are worthless mumbo jumbo and should be dispensed with. Although I do not think it is ever necessary to use the word “beauty” within physics, there is an important sense in which beauty can be used, has been used, is being used, perhaps subconsciously by some and consciously by others, wherein beauty has meaning and leads to truth.

The risk of a theoretical physicist defining what is meant by a “beautiful theory” is that it tends to focus on properties of theories that the individual theorist making the definition finds important, which devolves into a self-serving empty exercise of technicalities.

Let us then look to the long tradition of human expression for beauty outside the narrow realm of physics theories. There is within the practical art world — not just among philosophers of art — a long-revered definition that attempts to generalize the notion of beauty. It comes from Owen Jones’s *Grammar of Ornament* from 1856, a very influential art and design book out of London that has never been out of print these last ~164 years.

In one of his foundational propositions Owen defines beauty to be what is present when the mind reposes through lack of want:

“True beauty results from that repose which the mind feels when the eye, the intellect, and the affections, are satisfied from the absence of any want.”

This definition can apply fruitfully to theories within physics. The eye and affections are satisfied through the inscrutable but worthy intuitions of a serious and successful physicist (like a Dirac, and many others) who has experienced the delight of writing a new theory that explains more and is correct. And the intellect is satisfied through the “absence of any want” that a great theory accomplishes when at that time the main questions are answered and the main desires of the theory are fulfilled. For a time, one reposes and says, “Yes, this is good. It is beautiful what I now see.”

This reaction is an archetypal reaction manifested since the beginnings of recorded history. Even the author of Genesis says, “And God saw everything that he had made and behold, it was very good ... and he rested.”

It is another question whether beautiful theories correspond to ultimate truth, but I think they unambiguously correspond to solving conundrums of their time and station. And inasmuch as we believe there is progress in science — that solving the identified problems of a particular time generally pushes us forward and not haphazardly — we then can reasonably hold that beauty’s arrow arcs toward truth.